

What is the relationship between snacking and nutrient intake?

Conclusion

A limited body of evidence supports a positive relationship between snacking and nutrient intakes in children, adolescents, adults and older adults.

Grade: Limited

Overall strength of the available supporting evidence: Strong; Moderate; Limited; Expert Opinion Only; Grade not assignable For additional information regarding how to interpret grades [click here](#).

Evidence Summary Overview

This conclusion is based on the review of seven studies, three of which include children or adolescents (Macdiarmid et al, 2009; Maffeis et al, 2008; Sebastian et al, 2007) and four of which examine adults or older adults (Kerver et al, 2006; Ovaskainen et al, 2006; Stockman et al, 2005; Zizza et al, 2007). Not all nutrients are evaluated in all studies. In general, snacking is associated with higher intakes of macronutrients and dietary folate, vitamin C, calcium, magnesium, iron, potassium, and dietary fiber as well as total sugars and saturated fatty acids. Snacking by some adolescents and adults is associated with lower intakes of protein, fat, cholesterol, and iron, however

Evidence summary paragraphs (7):

Kerver et al, 2006 (positive quality), conducted a cross-sectional study to test the hypothesis that specific meal and snack patterns are associated with selected nutrient intakes in 15,978 US adults (≥ 20 years old). Using the 24-hour dietary recall from the Third National Health and Nutrition Examination Survey (NHANES), meal and snack patterns were described in relation to nutrient intakes. Meal patterns were further categorized into five most commonly reported meal and snack combinations by population percentages of breakfast (B), lunch (L), dinner (D) and snacks (S). The majority of subjects reported consuming two or more snacks (62.3%), while 25.2% of the population reported consuming one snack, and 12.5% reported consuming no snacks. Those reporting no snacks consumed the least amount of protein and total fat. Those consuming B, L, D, and ≥ 2 S had the highest energy and carbohydrate (CHO) and lowest fat intakes. The groups reporting B, L, D, and 1 S and B, L, D, and ≥ 2 S had the highest intakes of all micronutrients [folic acid ($322 \pm 4.69 \mu\text{g}$), vitamin C ($116 \pm 3.12 \text{mg}$), calcium ($942 \pm 13.5 \text{mg}$), magnesium ($339 \pm 3.01 \text{mg}$), iron ($17.5 \pm 0.29 \text{mg}$), potassium ($3,177 \pm 23.4 \text{mg}$), and fiber ($18.6 \pm 0.2 \text{g}$)], except cholesterol, vitamin B₆, and sodium, which were consumed in the highest amounts by the B, L, D, group (cholesterol= $323 \pm 10.2 \text{mg}$; vitamin B₆= $2.10 \pm 0.05 \text{mg}$; and sodium= $3,946 \pm 48.4 \text{mg}$). These findings suggest that meal and snack patterns may be markers for nutrient intakes and therefore diet quality.

Macdiarmid et al, 2009 (positive quality), used cross-sectional data (N=156) from the National Survey of Sugar Intake among children in Scotland to investigate the meal and snacking patterns of school-aged children (five-17 years old). Meals and snacks were defined by a food-based classification system based on “core” (foods normally eaten as part of a traditional meal) and “non core” (foods and drinks easily consumed without a meal). A meal was defined as an event containing one or more “core” foods with or without “non-core” foods or drinks, while a snack was defined as an event containing only “non core” foods or drinks. Seventy-eight percent of children had an average of between 2.5 and 3.5 meals per day and 98% of children ate one or more snacks. Boys ate similar number of snacks than girls, and children in the lowest socio-economic group ate fewer snacks than those in the highest socio-economic group. The number of meals and snacks eaten did not differ by age or body mass index (BMI) group. The median (inter-quartile

range) number of items eaten within a snacking event was two (one to two) and in a meal was four (three to five) items two (one to two) “core” and two (one to three) “non-core” items. The average daily intake of saturated fatty acid (SFA) and non-milk extrinsic sugars (NMES) (% food energy) was higher from snacks than meals, but there was no difference in total fat. Snacks accounted for approximately a fifth of the total daily energy intake and total fat intake, a quarter of SFA intake and almost 40% of NMES intake. The only difference by sex, age, BMI, and SIMD group was that girls derived a higher proportion of their daily intake of total fat from snacks than boys: 19.8(17.0-22.5) for boys, and 23.7 (21.0-26.3) for girls. To investigate whether the number of snacks eaten was related to nutrient intake, children were grouped as infrequent (average of less than two snacks per day) or frequent snackers (average of more than two snacks per day). Frequent snackers had a higher daily intake of NMES (% food energy), but there was no statistical difference (SD) in percentage food energy from SFA or total fat, or total daily energy intake. Frequent snackers had more total eating events per day and fewer meals than infrequent snackers. The proportion of subjects eating breakfast did not differ between snacker groups. The number of meals, snacks and total eating events per day and daily energy and nutrient intake (total fat, SFA and NMES) on weekdays did not differ between term-time and school holidays. The number of snacks eaten on weekdays and weekend days did not differ significantly. In conclusion, children tended to follow a traditional pattern of three meals a day, which was consistent between age and BMI subgroups and between term-time and holidays.

Maffei et al, 2008 (positive quality), conducted a prospective study to assess the type and number of snacks consumed weekly by a sample (N=1,837) of 8- to 10-year-old children from Italy. A questionnaire on the frequency of a child’s snacking (food and drink) weekly was filled out by a pediatrician. Energy and nutrient intakes were calculated by multiplying the frequency of weekly consumption by the nutrient composition of the portion size for each specific snack listed. Children consumed on average four snacks per day [mean values (SE) were: boys: 3.9 (0.07); girls: 3.8 (0.07), P=0.27]. The favorite snacks were: Fruit juice, fruit, bread with cold cuts, milk, tea, soft drinks, brioche, crackers, yogurt, bread, and cookies. Children preferred salty snacks to sweet snacks; they consumed 8.4 (0.16) servings per week of savory snacks vs. 7.2 (0.13) servings per week of sweet snacks (P<0.001). Energy intake and macronutrient composition was not statistically different between boys and girls. Macronutrient composition of snack serving was: 8.3 (0.1)% of protein, 64 (0.28)% of CHO, and 27.7 (0.25)% of fat from total energy.

Ovaskainen et al, 2006 (positive quality), used a random sample from a cross-sectional population survey (FINRISK 2002) in Finland, to assess prominence of snacks in energy intake. Dietary data were collected for 2,007 adults by using a computer-assisted 48-hour dietary recall in the national FINDIET. The interviewer selected the meal name from the following alternatives: breakfast, lunch, dinner, drink, evening snack, other snack and other eating event. To simplify the variety of meal, meal type was divided into two categories: main meals and snacks. Daily energy was mostly derived from main meals comprising traditional mixed dishes, milk and bread. However, a snack-dominating meal pattern was observed in 19% of men and 24% of women. This meal pattern was associated with urbanization in both genders and with physical work in men. Higher sucrose intake and lower intake of micronutrients (not statistically different) were typical of the snack-dominating meal pattern compared to the others. In this population sodium content of the diet was lower for those with a snack-dominating meal pattern than the main-meal dominating diet group.


Sebastian et al, 2007 (positive quality), conducted a cross-sectional study to determine how snacking level impacts intake of nutrients and food groups. Dietary data based on 24-hour recall from 4,357 adolescents, 12 to 19 years of age participating in the NHANES 2001-2004 were analyzed. Food energy, CHO, total sugars, and vitamin C intake were positively associated, whereas protein and fat intake were negatively associated, with snacking frequency. Fruit intake increased, whereas solid fat intake decreased, as snacking incidence rose. Increasing snacking frequency was also associated with a greater likelihood of meeting milk and oil recommendations for boys and meeting fruit recommendations for both genders. Non-Hispanic black adolescents were less likely to meet their milk recommendations at low and high snacking levels and more likely to meet their fruit recommendations at high levels only. Foods consumed as snacks provided 12-39% of the day’s total number of portions of the five MyPyramid food groups, 35% of total discretionary calorie intake, and 43% of total added sugar intake.


Stockman et al, 2005 (positive quality), conducted a retrospective cohort study to determine and compare



the distribution of energy and nutrient intakes among meals and snacks, and related eating occasion frequency to the BMI of 180 healthy adolescents males (14 to 18 years old) recruited from local school and community groups in Canada. Anthropometric information and 24-hour dietary recall on three consecutive days, including two weekdays and one weekend day, were evaluated. Also, subjects were instructed to self-report the type of every eating occasion, such as breakfast, lunch, dinner, and snacks. Snacks tended to contribute fewer nutrients than meals; however, only cholesterol and iron intakes were statistically lower at snacks relative to all meals. Overall, the average daily number of snacks consumed was 1.63, with 77% of subjects consuming an average of at least one snack per day.


Zizza et al, 2007 (positive quality), used cross-sectional data from the NHANES 1999-2002 to compare the diets of snackers and nonsnackers, and to evaluate the influence of snacking on energy intakes and energy density in older adults. This study included 2,002 adults aged 65 years and older, and one day 24-hour dietary data was analyzed to classify eating occasions. The prevalence of snacking was high (84%) among this age group, and snackers had significantly higher daily intakes of energy, protein, CHO, and total fat. Alcohol intakes were not significantly different. In this population, snacks contributed almost a quarter of the energy and CHO intakes and a fifth of the daily fat intake. Also, snacking contributed 14% of daily protein intakes. Snackers had, on average, two and a half snacking occasions per day, with each snacking occasion contributing 150kcal. The average energy contribution of meals was not different between snackers and nonsnackers. The energy density of meals is significantly greater for snackers than for non-snackers. In conclusion, results from this study demonstrate that snacking is an important dietary behavior among older adults.


 [View table in new window](#)


Author, Year, Study Design, Class, Rating	Study Subjects	Data Collection, Instruments and Methods	Prevalence of Snacking	Key Outcomes
Kerver JM, Yang EJ et al, 2006 Study Design: Cross-sectional design Class: D Rating: 	Data from the NHANES Study III, 1988-1994. N=15,978. Age: ≥ 20 years old adults. 52.6% female. 82.7% non-Hispanic White; 11.8% non-Hispanic Black; 5.5% Mexican-American.	24-hour diet recall Self-reported eating intake patterns of Breakfast (B), Lunch (L), Dinner (D), Snacks (S). Most common meal and snack combinations: * B, L, D, ≥ 2 S * B, L, D, 1 S * B, L, ≥ 2 S * B, L, D * L, D, ≥ 2 S * Other.	From the population: 62.3% reported consuming two or more snacks. 25.2% reported consuming one snack. 12.5% reported consuming no snacks.	Those reporting no snacks consumed the least amount of protein and total fat. Those consuming B, L, D, and ≥ 2 S had the highest energy and CHO and lowest fat intakes. The group reporting B, L, D, and 1 S and B, L, D, and ≥ 2 S had the highest intakes of all micronutrients: folic acid ($322 \pm 4.69\mu\text{g}$), vitamin C ($116 \pm 3.12\text{mg}$), calcium ($942 \pm 13.5\text{mg}$), magnesium ($339 \pm 3.01\text{mg}$), iron

				<p>(17.5±0.29mg), potassium (3,177±23.4mg), and fiber (18.6±0.2g).</p> <p>The group reporting B, L, D had the highest intake of cholesterol, vitamin B₆, and sodium (cholesterol = 323±10.2mg; vitamin B₆ = 2.10±0.05mg; and sodium = 3,946±48.4mg).</p>
<p>Macdiarmid J, Loe J et al, 2009</p> <p>Study Design: Cross-sectional study</p> <p>Class: D</p> <p>Rating: </p>	<p>Data from a cross-sectional data from the national Survey of Sugar Intake among children in Scotland.</p> <p>N=156.</p> <p>5-17 years old adolescents.</p>	<p>Four-day non-weighed diet diary (three weekdays and one weekend).</p> <p>Snack-eating event containing only 'non core' foods or drinks.</p> <p>'Non core' was defined as foods and drinks easily consumed without a meal.</p>	<p>98% of children ate one or more snacks per day.</p> <p>N=86 Infrequent snackers or having ≤two snacks per day.</p> <p>N=70 Frequent snackers or having >two snacks per day.</p>	<p>Children in the lower socio-economic group ate fewer snacks than those in the high socio-economic group.</p> <p>The number of meals and snacks eaten did not differ by age or BMI group.</p> <p>The median (inter-quartile range) number of items eaten within a snacking event was two.</p> <p>The average daily intake of saturated fatty acids (SFA) and non-milk extrinsic sugars (NMES) (% food energy) was higher from snacks than meals, but there was no difference in total fat.</p> <p>Snacks accounted for approximately a fifth of the total daily energy intake and total fat intake, a quarter of SFA intake and almost 40% of NMES intake.</p>

				<p>Total fat from snacks: 19.8(17.0-22.5) for boys, and 23.7 (21.0-26.3) for girls.</p> <p>Frequent snackers had a higher daily intake of NMES (% food energy).</p>
<p>Maffeis et al 2008</p> <p>Study Design: Prospective cohort study</p> <p>Class: B</p> <p>Rating: </p>	<p>Children were recruited from three different cities in Italy (Verona, Pisa and Naples); 2003.</p> <p>N=1,837 (924 males; 913 females).</p> <p>Age: 8-10 years old.</p>	<p>Questionnaire on the frequency of a child's snacking.</p> <p>Energy and nutrient intakes were calculated by multiplying the frequency of weekly consumption by the nutrient composition of the portion size for each specific snack listed.</p> <p>List of 22 snacks (foods and drinks) classified by sweet and savory.</p>	<p>Average of four snacks per day.</p>	<p>In both sexes, the favorite snacks were: fruit juice, fruit, bread with cold cuts, milk, tea, soft drinks, brioche, crackers, yogurt, bread, and cookies.</p> <p>Children preferred salty snacks to sweet snacks; they consumed 8.4 (0.16) servings per week of savory snacks vs 7.2 (0.13) servings per week of sweet snacks (P<0.001).</p> <p>Energy intake and macronutrient composition was not statistically different between boys and girls [(8.3 (0.1)% of protein, 64(0.28)% of CHO, and 27.7 (0.25)% of fat from total energy].</p>
<p>Ovaskainen ML, Reinivuo H et al, 2006</p> <p>Study Design: Cross-sectional design</p> <p>Class: D</p> <p>Rating: </p>	<p>Data from a cross-sectional population survey (FINRISK 2002) in Finland.</p> <p>N=2,007 adults (912 males; N=1,095 females).</p> <p>Age: 25-64 years.</p>	<p>Dietary data collected by a computerized multiphased 48-hour recall by trained nutritionists.</p> <p>Self-reported type of meal from the following alternatives: Breakfast, lunch,</p>	<p>Snack-dominating meal pattern was observed in 19% of men and 24% of women.</p>	<p>Snack dominating pattern was associated with urbanization in both genders and with physical work in men.</p> <p>Higher sucrose intake and lower intake of micronutrients (not statistically different) were typical of the snack-dominating meal</p>

		dinner, snack, drink, evening snack, and other eating event.		<p>pattern compared to the others.</p> <p>Sodium content of the diet was lower for those with a snack-dominating meal pattern [3,636 (92)mg for men, and 2,544 (53)mg for women] than the main-meal dominating diet group [3,992 (52) for men and 2,764(32)mg for women].</p>
<p>Sebastian RS, Cleveland LE et al, 2008</p> <p>Study Design: Cross-Sectional Study</p> <p>Class: D</p> <p>Rating: </p>	<p>Data from the NHANES 2001-2004.</p> <p>N=4,357.</p> <p>Age: 12-19 year old adolescents.</p>	<p>One 24-hour diet recall, collected in person by a trainer interviewer.</p> <p>$P \leq 1$ for all analysis was used.</p> <p>Eating occasion was self-reported from a defined list.</p> <p>Snacks occasions were described as: “snack,” “beverage,” “extended consumption” and the Spanish terms “merienda,” “entre comida,” “bebida,” “botana,” and “bocadillo.”</p>	<p>Mean nutrient intake by snacking category:</p> <p>0 Snacks N=502</p> <p>1 Snack N=1,111</p> <p>2 Snacks N=1,126</p> <p>3 Snacks N=834</p> <p>4+ Snacks N=784.</p>	<p>As snacking ↑:</p> <p>Energy-adjusted intakes for both genders reflected an ↑ in CHO, and this was paralleled by an ↑ in total sugar intake.</p> <p>Adjusted protein and fat were significantly lower in the diets of boys and girls.</p> <p>Intakes of vitamin A, vitamin E, and magnesium intake significantly ↑ for boys, and vitamin C intake significantly ↑ for both boys and girls.</p> <p>Intakes of vitamin B₆, folate, calcium, iron, and phosphorus were not significantly affected.</p> <p>Fruit intake ↑ and solid fat intake ↓ for both adolescent boys and girls.</p> <p>Intake of added sugars ↑ for girls only.</p>

				<p>Significantly improved the likelihood of meeting fruit recommendations for both genders and of meeting milk and oils recommendations for boys.</p> <p>More than one-third of all fruit portions and oils, about one-quarter of all grain and milk portions, and lesser proportions of vegetables and meat/beans portions were consumed at snacking occasions.</p> <p>Snacks contributed more than one-third of discretionary calories and added sugars, and approximately one-fourth of solid fats.</p>
<p>Stockman NK, Schenkel TC et al, 2005</p> <p>Study Design: Prospective cohort study</p> <p>Class: B</p> <p>Rating: </p>	<p>Data from the local high school community in Canada.</p> <p>N=180.</p> <p>Age: 14-18 year old adolescents</p>	<p>Three-day 24-hour recall.</p> <p>Eating occasion was self-reported.</p>	<p>Daily number of snacks consumed was 1.63 with 77% of subjects consuming an average of at least one snack per day.</p>	<p>Snacks tended to contribute fewer nutrients than meals.</p> <p>Cholesterol and iron intakes were statistically lower at snacks relative to all meals.</p> <p>Protein = $13.4 \pm 0.97\text{g}$ from a total daily intake of $96.8 \pm 2.29\text{g}$</p> <p>CHO = $85.7 \pm 5.04\text{g}$ from a total of $343.3 \pm 7.57\text{g}$.</p> <p>Total fat = $22.4 \pm 1.37\text{g}$ from a total of $96.0 \pm 2.32\text{g}$.</p> <p>Saturated fat = 7.55 ± 0.50 from a total of $31.0 \pm 0.84\text{g}$.</p>

				<p>Cholesterol = 34.3±3.24 from a total of 273.5±10.7mg.</p> <p>Dietary fiber = 2.89±0.21g from a total of 14.0±0.44g.</p> <p>Calcium = 177.1±15.8mg from a total of 1,022 ±37.9mg.</p> <p>Iron = 2.24 ±0.23mg from a total of 15.5±0.44mg.</p> <p>Sodium = 684.8±46.6 mg from a total of 4,334±98.9 mg).</p>
<p>Zizza CA, Tayie FA et al, 2007</p> <p>Study Design: Cross-Sectional Study</p> <p>Class: D</p> <p>Rating: </p>	<p>Data from the NHANES 1999-2002.</p> <p>N=2,002.</p> <p>Age: ≥65 year old adults (categorized as: 65-74 years; 75-84 years; ≥85 years).</p>	<p>One 24-hour diet recall, collected in person by a trainer interviewer.</p> <p>Eating occasion was self-reported from a defined list.</p> <p>Snacks occasions were describe as: “snack,” “beverage,” “extended consumption” and the Spanish terms “merienda,” “entre comida,” “bebida,” “botana,” and “bocadillo.”</p>	<p>Prevalence of snacking 84%.</p>	<p>Snackers had, on average, two and a half snacking occasions per day, with each snacking occasion contributing 150kcal.</p> <p>Snackers had significantly higher daily intakes of energy, protein, CHO, and total fat.</p> <p>Alcohol intakes were not SD.</p> <p>Snacking contributed almost a quarter of their energy and CHO intakes and a fifth of their daily fat intakes.</p> <p>Snacking contributed 14% of their daily protein intakes.</p> <p>The average energy contribution of meals was not different between snackers and non-snackers.</p>

				The energy density of meals is significantly greater for snackers than for non-snackers.
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Research Design and Implementation Rating Summary


For a summary of the Research Design and Implementation Rating results, [click here](#).


Worksheets

 [Kerver JM, Yang EJ, Obayashi S, Bianchi L, Song WO. Meal and snack patterns are associated with dietary intake of energy and nutrients in US adults. *J Am Diet Assoc* 2006; 106: 46-53.](#)

 [Macdiarmid J, Loe J, Craig LC, Masson LF, Holmes B, McNeill G. Meal and snacking patterns of school-aged children in Scotland. *Eur J Clin Nutr* 2009; 63: 1,297-1,304.](#)

 [Maffeis C, Grezzani A, Perrone L, Del Giudice EM, Saggese G, Tatò L. Could the savory taste of snacks be a further risk factor for overweight in children? *J Pediatr Gastroenterol Nutr*. 2008 Apr;46\(4\):429-37.](#)

 [Ovaskainen ML, Reinivuo H, Tapanainen H, Hannila ML, Korhonen T, Pakkala H. Snacks as an element of energy intake and food consumption. *Eur J Clin Nutr*. 2006; 60: 494-501.](#)

 [Sebastian RS, Cleveland LE, Goldman JD. Effect of snacking frequency on adolescents' dietary intakes and meeting national recommendations. *J Adolesc Health*. 2008 May; 42 \(5\): 503-11. Epub 2008 Feb 7.](#)

 [Stockman NK, Schenkel TC, Brown JN, Duncan AM. Comparison of energy and nutrient intakes among meals and snacks of adolescent males. *Prev Med*. 2005 Jul; 41 \(1\): 203-210. Epub 2004 Dec 10.](#)

 [Zizza CA, Tayie FA, Lino M. Benefits of snacking in older Americans. *J Am Diet Assoc*. 2007; 107: 800-806.](#)